CHROMOSOME NUMBERS OF GRASSES (POACEAE) FROM SOUTHERN AFRICA. I.[1]

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ABSTRACT

Chromosome numbers and meiotic behavior are reported for 8 Namibian and 55 South African grass collections representing 30 genera and 45 species. First chromosome counts are reported for the following 13 species: Andropogon amethystinus, n = *ca. 30;* Anthephora argentea, n = *9;* Brachiaria chusqueoides, n = *9;* B. glomerata, n = *9;* Centropodia glauca, n = *24;* Danthoniopsis parva, n = *12;* Digitaria diversinervis, n = *18;* Ehrharta longigluma, n = *12;* Miscanthidium capense, n = *15;* Panicum monticolum, n = *27;* P. schinzii, n = *9;* Triraphis fleckii, n = *10;* T. ramosissima, n = *10. Chromosome counts differing from any previously reported numbers were obtained for six species. Of the 45 species, 57% are polyploid and 43% are diploid.*

This paper is part of a series contributing to a broader knowledge of chromosome numbers of African grasses. In the first we reported new chromosome counts for Zimbabwean grasses (Davidse et al., 1986). In this report we present chromosome counts for 63 collections representing 45 species and 30 genera of South African and Namibian grasses.

The major studies dealing with chromosome numbers of South African grasses are those of Moffett & Hurcombe (1949), Pienaar (1955), De Wet (1954a, b, 1958, 1960), De Wet & Anderson (1956), Spies & Du Plessis (1986a, b, 1987a, b, 1988), and Spies & Jonker (1987), although other smaller scattered reports, mostly dealing with individual genera, have also been made.

MATERIALS AND METHODS

All cytological samples studied were collected and fixed in the field January to March 1974. The methodology is the same as explained in Davidse et al. (1986). Voucher specimens (Table 1) are deposited at MO and PRE. The suprageneric classification used in this paper follows the one of Clayton & Renvoize (1986) except that we recognize the tribe Brachypodieae.

RESULTS AND DISCUSSION

A complete list of the species studied, their chromosome numbers, the generic base number derived from the determined number, and the voucher specimens is given in Table 1, where totally new counts and counts differing from any previous count for the same taxon are also identified. We illustrate only new counts (Figs. 1–4, 7, 9, 10, 15–20) and counts different from any other for a given taxon (Figs. 5, 6, 8, 11, 13, 14). Unless otherwise indicated, meiosis was regular for all taxa listed in Table 1. Comments on chromosome or base numbers without reference to original sources are based on the indices of Fedorov (1969), Moore (1973, 1974, 1975), and Goldblatt (1981, 1984, 1985).

TRIBE ANDROPOGONEAE

Diheteropogon amplectens was previously reported to be tetraploid $2n = 40$ from a Zimbabwean population (Moffett & Hurcombe, 1949). We found two collections from the Transvaal to be diploid with $n = 10$ (Fig. 13).

Heteropogon melanocarpus was previously known only as an aneuploid ($2n = 22$) from Zimbabwe (Moffett & Hurcombe, 1949). Our count establishes the existence of a eudiploid population ($n = 10$; Fig. 14) in the Transvaal.

We determined both *Miscanthidium capense* (Fig. 15) and *M. junceum* to have $n = 15$. This confirms earlier counts for *M. junceum* (De Wet & Anderson, 1956; De Wet, 1958; De Wet, 1960, as *M. teretifolium*). In addition, Brett (1954) reported *M. violaceum* to have $2n = 28$. This strong-

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TABLE 1. *Chromosome numbers of South African (without country designation) and Namibian (South West African) grasses.*

Taxon	Chromosome (n) and Generic Base Number (x)	Locality and Voucher
ANDROPOGONEAE		
Andropogon	$x = 10$	
amethystinus Steud.	n = ca. 30[a]	Orange Free State: 33 km SW of Witsieshoek, *Davidse 6993*
Cymbopogon	$x = 10$	
excavatus (Hochst.) Stapf ex Burtt Davy	$n = 10$	Transvaal: 5 km NE of Haenertsburg, *Davidse & Ellis 5839*
validus (Stapf) Stapf ex Burtt Davy	$n = 10$	Transvaal: 5 km NE of Haenertsburg, *Davidse & Ellis 5840*
Diheteropogon	$x = 10$	
amplectens (Nees) Clayton	$n = 10$[b]	Transvaal: 0.5 km NE of Haenertsburg, *Davidse & Ellis 5832*; 15 km NE of Cullinan, *Davidse 6005*
Eulalia	$x = 10$	
villosa (Thunb.) Nees	$n = 10$	Natal: 33 km S of Nqutu, *Davidse 6852*. Transvaal: 5 km NE of Haenertsburg, *Davidse & Ellis 5836*
Heteropogon	$x = 10$	
melanocarpus (Ell.) Benth.	$n = 10$[b]	Transvaal: Kruger National Park, Dzundwini Hills, 20 km N of Babalala, *Davidse 5853*
Hyparrhenia	$x = 10$	
hirta (L.) Stapf	$n = 20$	Natal: Belelasberg, 6 km S of Wakkerstroom, *Davidse 6758*
Ischaemum	$x = 10$	
afrum (J. F. Gmel.) Dandy	$n = 10$	Transvaal: Kruger National Park, Babalala, *Davidse 5843*
Miscanthidium	$x = 15$	
capense (Nees) Stapf	$n = 15$[a]	Natal: 7 km N of Kranskop, *Davidse 6923*
junceum (Stapf) Stapf	$n = 15$	Natal: 11 km NW of Utrecht, *Davidse 6803*
Monocymbium	$x = 10$	
ceresiiforme (Nees) Stapf	$n = 10$	Transvaal: Magoebaskloof, 3 km NE of Haenertsburg, *Davidse & Ellis 5812*
ARUNDINEAE		
Centropodia	$x = 12$	
glauca (Nees) T. A. Cope	$n = 24$[a]	Cape Province: 59 km W of Olifantshoek, *Davidse & Loxton 6436*. Namibia: Gibeon District, 41 km E of Gochas, *Davidse & Loxton 6367*
ARUNDINELLEAE		
Danthoniopsis	$x = 12$	
parva (J. B. Phipps) Clayton	$n = 12$[a]	Transvaal: Zoutpansberg, *Davidse & Ellis 5930*
AVENEAE		
Agrostis	$x = 7$	
lachnantha Nees	$n = 21$[b]	Transvaal: 2.5 km NW of Wakkerstroom, *Davidse 6742*. Orange Free State: 33 km SW of Witsieshoek, *Davidse 6988*
Helictotrichon	$x = 7$	
turgidulum (Stapf) Schweick.	$n = 14$	Orange Free State: 33 km SW of Witsieshoek, *Davidse 6967*

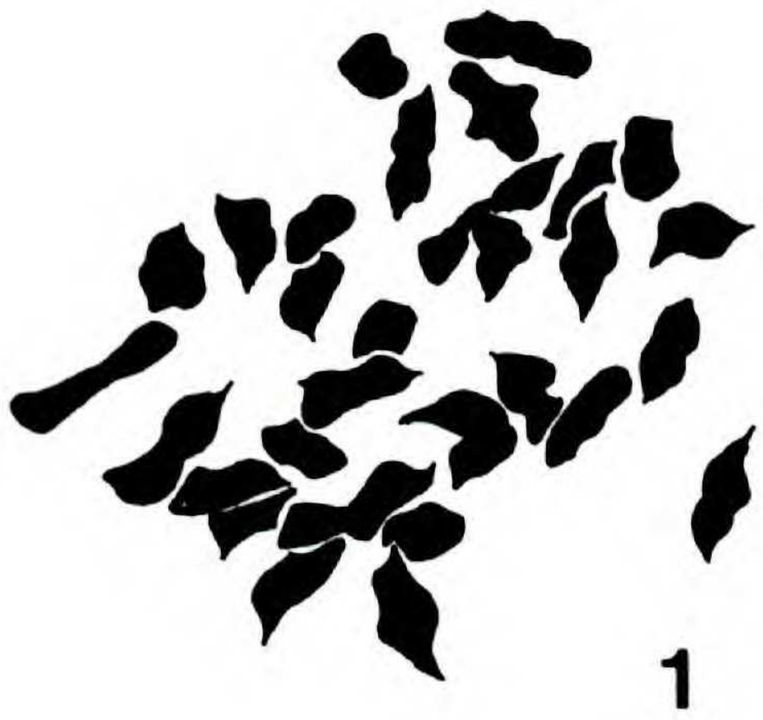
TABLE 1. *Continued.*

Taxon	Chromosome (*n*) and Generic Base Number (*x*)	Locality and Voucher
Koeleria	*x* = 7	
capensis (Steud.) Nees	*n* = 7	Orange Free State: 33 km SW of Witsieshoek, *Davidse 6981*
BRACHYPODIEAE		
Brachypodium	*x* = 9	
flexum Nees	*n* = 9	Transvaal: 6 km NE of Haenertsburg, *Davidse & Ellis 5825*. Natal: Belelasberg, 6 km S of Wakkerstroom, *Davidse 6787*
EHRHARTEAE		
Ehrharta	*x* = 12	
erecta Lam.	*n* = 12	Transvaal: Magoebaskloof, 3 km NE of Haenertsburg, *Davidse & Ellis 5810*
longigluma C. E. Hubb.	*n* = 12[a]	Orange Free State: 33 km SW of Witsieshoek, *Davidse 6974*
ERAGROSTIDEAE		
Triraphis	*x* = 10	
fleckii Hack.	*n* = 10[a]	Namibia: Gibeon District, 74 km E of Gochas, *Davidse & Loxton 6381*
ramosissima Hack.	*n* = 10[a]	Namibia: Keetmanshoop District, 2–3 km E of Groot Karasberge, *Davidse & Loxton 6252*; Warmbad District, 36 km W of Ariamsvlei, *Davidse & Loxton 6416*
ORYZEAE		
Leersia	*x* = 12	
hexandra Swartz	*n* = 24	Transvaal: 11 km WSW of Koster, *Davidse & Loxton 6012*; 2 km S of Vanderyst, *Davidse 6691*
Prosphytochloa	*x* = 12	
prehensilis (Nees) Schweick.	*n* = 12	Transvaal: Magoebaskloof, 3 km NE of Haenertsburg, *Davidse & Ellis 5811*. Natal: 42 km S of Silutshana, *Davidse 6898*
PANICEAE		
Alloteropsis	*x* = 9	
semialata (R. Br.) Hitchc.	*n* = 9	Transvaal: Magoebaskloof, 3 km NE of Haenertsburg, *Davidse & Ellis 5813*
Anthephora	*x* = 9	
argentea Goossens	*n* = 9[a]	Cape Province: 34.4 km NE of Kuruman, *Davidse & Loxton 6063*
Brachiaria	*x* = 9	
chusqueoides (Hack.) Clayton	*n* = 9[a]	Natal: Tinley Manor Beach, 55 km NE of Durban, *Davidse 6938*
deflexa (Schumach.) C. E. Hubb. ex Robyns	*n* = 9	Transvaal: Kruger National Park, 8 km N of Babalala, *Davidse & Ellis 5847*
eruciformis (J. E. Sm.) Griseb.	*n* = 9	Transvaal: 27 km SE of Bethal, *Davidse 6708*
glomerata (Hack.) A. Camus	*n* = 9[a]	Cape Province: 21 km WSW of Keimoes, *Davidse & Loxton 6124*. Namibia: Gibeon District, 25 km E of Gochas, *Davidse & Loxton 6358*
nigropedata (Munro ex Fical. & Hiern) Stapf	*n* = 36[b]	Transvaal: Kruger National Park, Dzundwini Hills, 20 km N of Babalala, *Davidse & Ellis 5852*

TABLE 1. *Continued.*

Taxon	Chromosome (n) and Generic Base Number (x)	Locality and Voucher
Digitaria	$x = 9$	
diversinervis (Nees) Stapf	$n = 18$[a]	Natal: Tinley Manor Beach, 55 km NE of Durban, *Davidse 6949*
eriantha Steud.	$n = 9$	Cape Province: 25 km SW of Olifantshoek, *Davidse & Loxton 6102*. Namibia: Keetmanshoop District, 2–3 km E of Groot Karasberge, *Davidse & Loxton 6279*
	$n = 18$	Cape Province: 75 km SW of Vryburg, *Davidse & Loxton 6040*
longiflora (Retz.) Pers.	$n = 9$	Natal: 3 km S of Kingsley, *Davidse 6839*. Transvaal: Kruger National Park, 12 km NW of Punda Milia, *Davidse & Ellis 5924*
ternata (A. Rich.) Stapf	$n = 18$	Transvaal: 27 km SE of Bethal, *Davidse 6712*
Echinochloa	$x = 9$	
haploclada (Stapf) Stapf	$n = 9$	Transvaal: Kruger National Park, 14 km SE of Punda Milia, *Davidse & Ellis 5856*
	$n = 27$[b]	Transvaal: Kruger National Park, Machayi Pan, *Davidse & Ellis 5869*; Kruger National Park, 14 km SE of Punda Milia, *Davidse & Ellis 5857*
Panicum	$x = 9$	
coloratum L. var. *coloratum*	$n = 9$	Namibia: Keetmanshoop District, 2–3 km E of Groot Karasberge, *Davidse & Loxton 6226*
	$n = 18$	Namibia: Gibeon District, Nosob River, 100 km E of Gochas, *Davidse & Loxton 6392*
maximum Jacq.	$n = 16$	Transvaal: Kruger National Park, Dzundwini Hills, 20 km N of Babalala, *Davidse & Ellis 5854*
monticolum Hook f.	$n = 27$[a]	Transvaal: Woodbush Forest Reserve, *Davidse & Ellis 5826*
schinzii Hack.	$n = 9$[a]	Transvaal: 2 km S of Vanderyst, *Davidse 6692*; 2 km NE of Haenertsburg, *Davidse & Ellis 5820*; 5 km SE of Morgenzon, *Davidse 6719*
stapfianum Fourc.	$n = 9$[b]	Cape Province: 75 km SW of Vryburg, *Davidse & Loxton 6043*
Paspalidium	$x = 9$	
obtusifolium (Del.) Simpson	$n = 18$	Transvaal: Kruger National Park, Machayi Pan, *Davidse & Ellis 5868*
Pennisetum	$x = 9$	
villosum R. Br. ex Fresen	$n = 27$	Transvaal: just SE of Amersfoort, *Davidse 6731*
Rhynchelytrum	$x = 9$	
nerviglume (Franch.) Chiov.	$n = 18$	Natal: 11 km NW of Utrecht, *Davidse 6806*; 33 km S of Nqutu, *Davidse 6861*
Setaria	$x = 9$	
megaphylla (Steud.) Dur. & Schinz	$n = 27$	Transvaal: 2 km NE of Haenertsburg, *Davidse & Ellis 5817*
Urochloa	$x = 9$	
panicoides Beauv.	$n = 18$	Natal: 39 km S of Utrecht, *Davidse 6825*

[a] First chromosome count for the species.
[b] Chromosome count differing from any previous count for the species.



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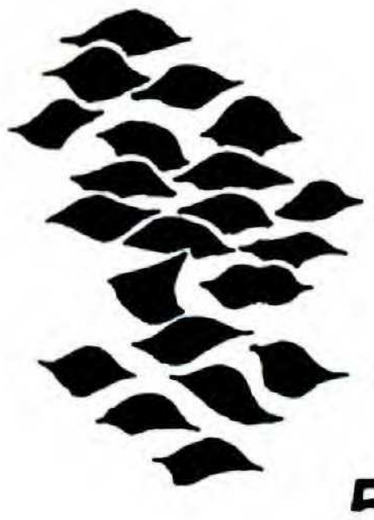

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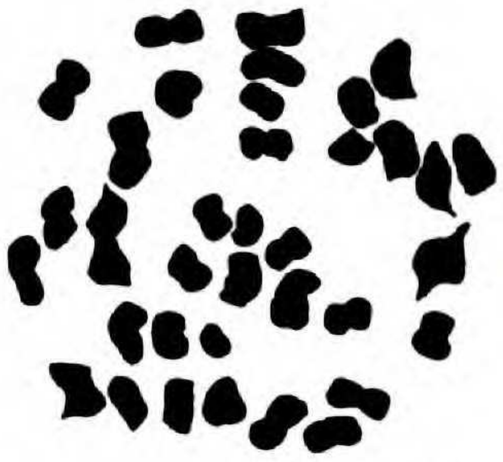

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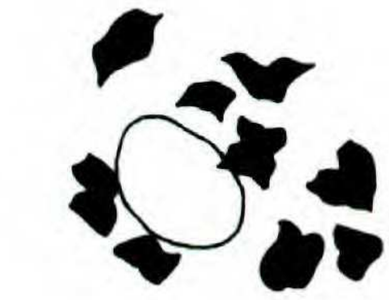

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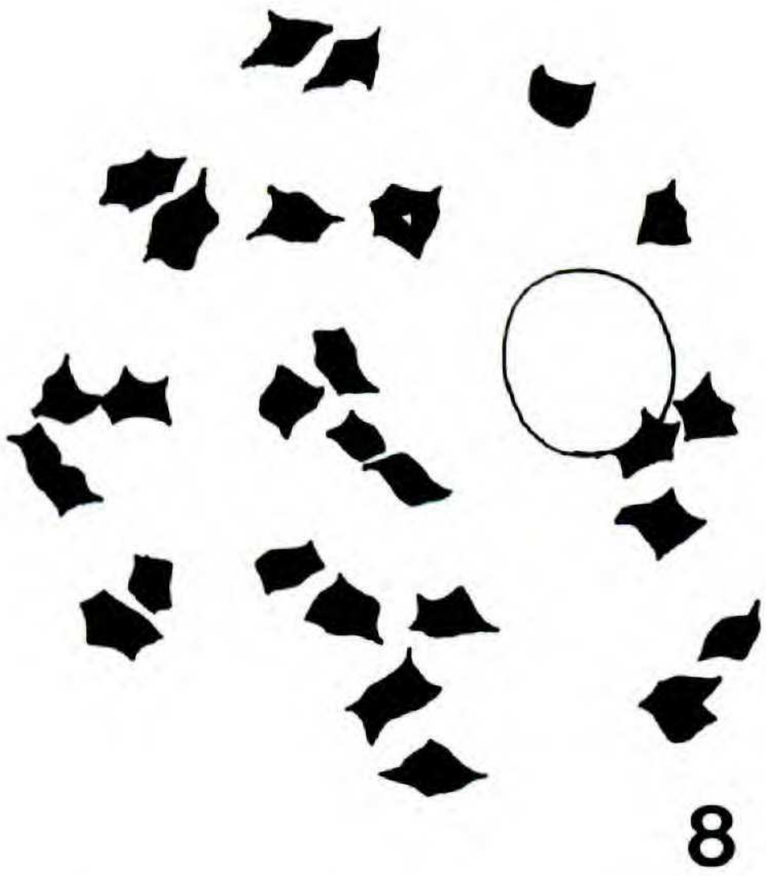

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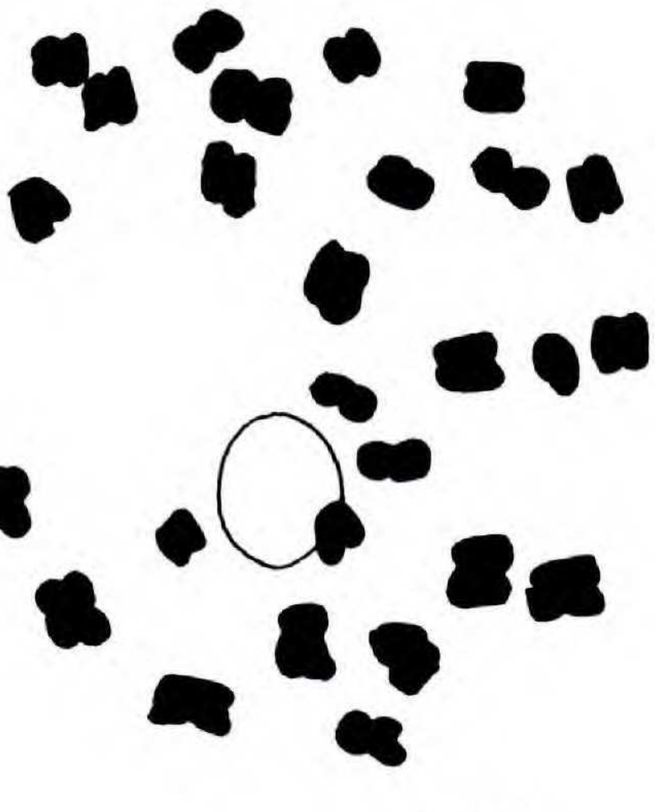

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FIGURES 1–11. *Camera lucida drawings of meiotic chromosomes of South African grasses.*—1. Andropogon amethystinus, n = *ca. 30, diakinesis.*—*2.* Centropodia glauca, n = *24, diakinesis.*—*3.* Triraphis fleckii, n = *10, diakinesis.*—*4.* Triraphis ramosissima, n = *10, diakinesis.*—*5.* Agrostis lachnantha, n = *21, metaphase I.*—*6.* Brachiaria nigropedata, n = *36, diakinesis.*—*7.* Digitaria diversinervis, n = *18, diakinesis.*—*8.* Echinochloa haploclada, n = *27, diakinesis.*—*9.* Panicum monticolum, n = *27, diakinesis.*—*10.* Panicum schinzii, n = *9, diakinesis.*—*11.* Panicum stapfianum, n = *9, diakinesis. Scale line = 10 μm.*

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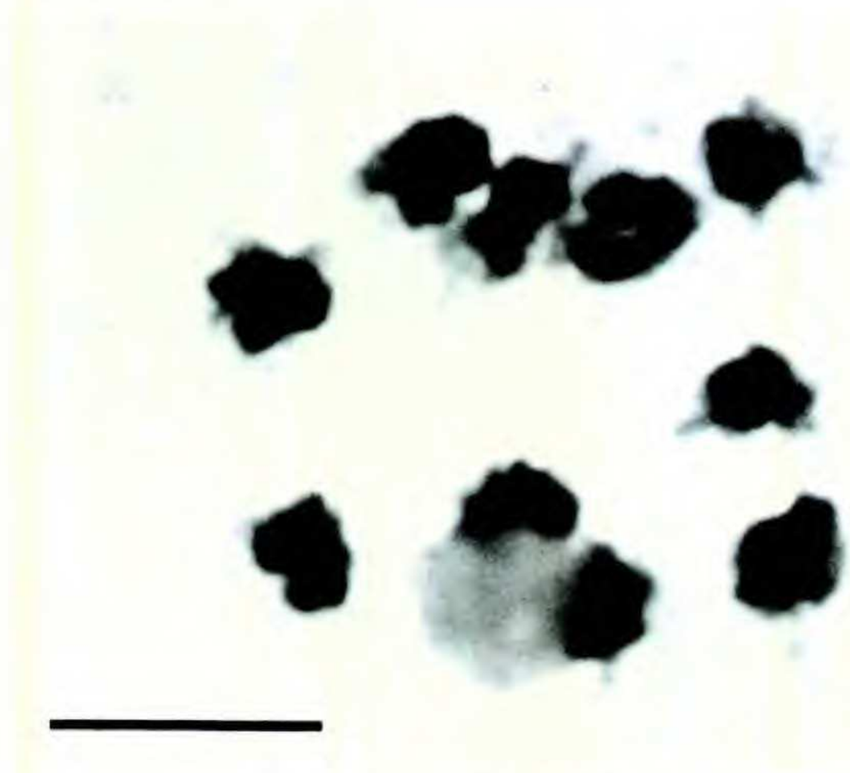
FIGURES 12–20. *Photomicrographs of meiotic chromosomes of South African grasses.*—*12.* Cymbopogon excavatus, n = *10, diakinesis.*—*13.* Diheteropogon amplectens, n = *10, diakinesis.*—*14.* Heteropogon melanocarpus, n = *10, diakinesis.*—*15.* Miscanthidium capense, n = *15, diakinesis.*—*16.* Danthoniopsis parva, n = *12, diaki-*



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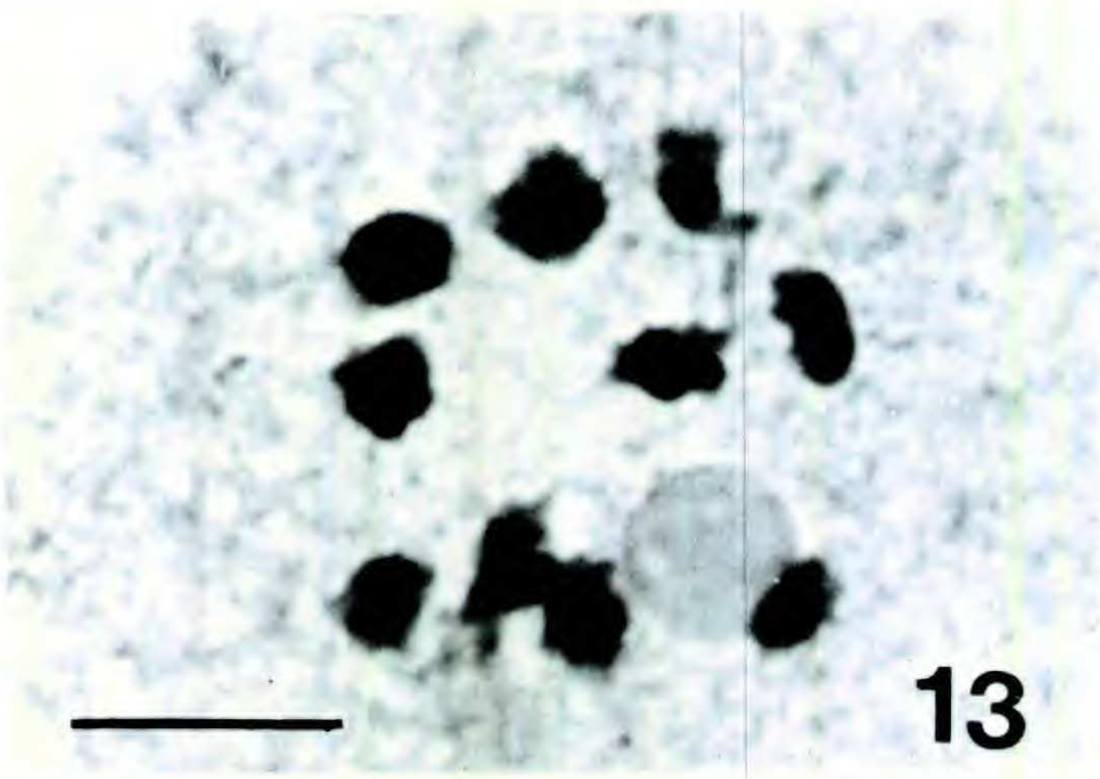

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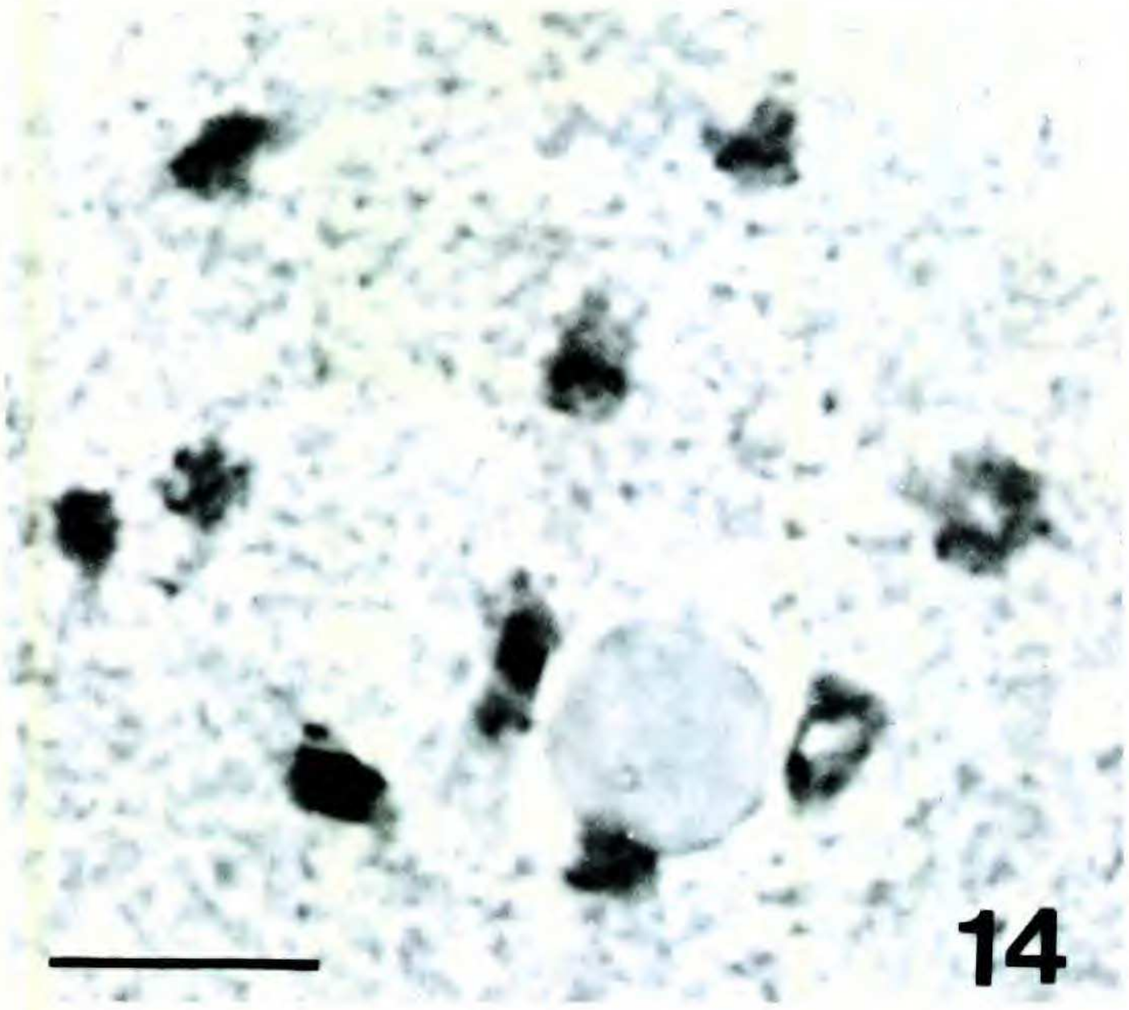

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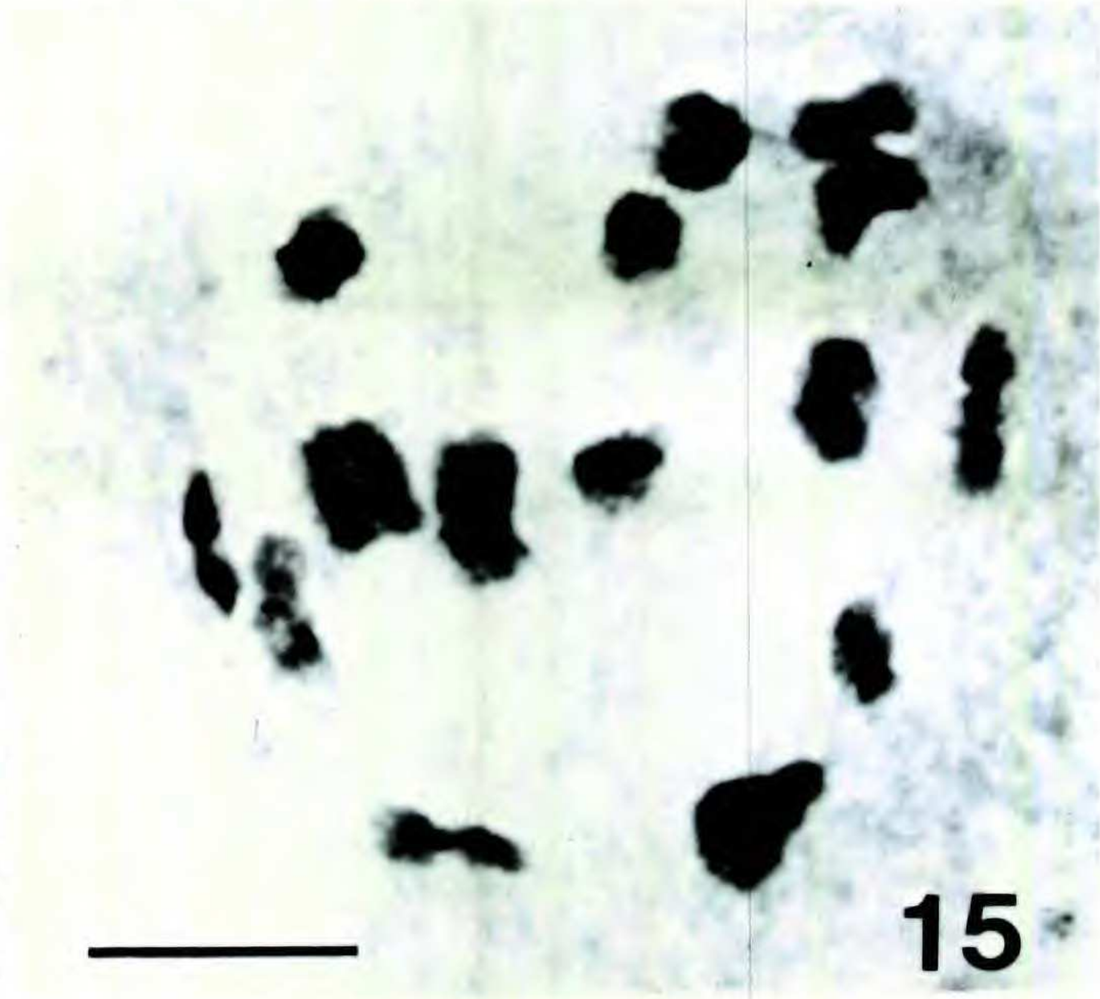

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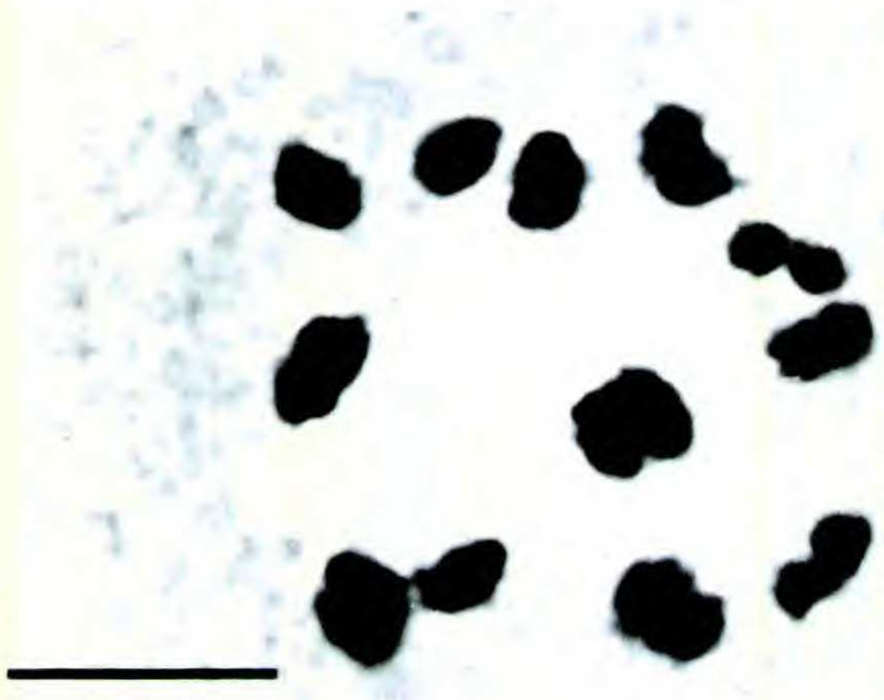

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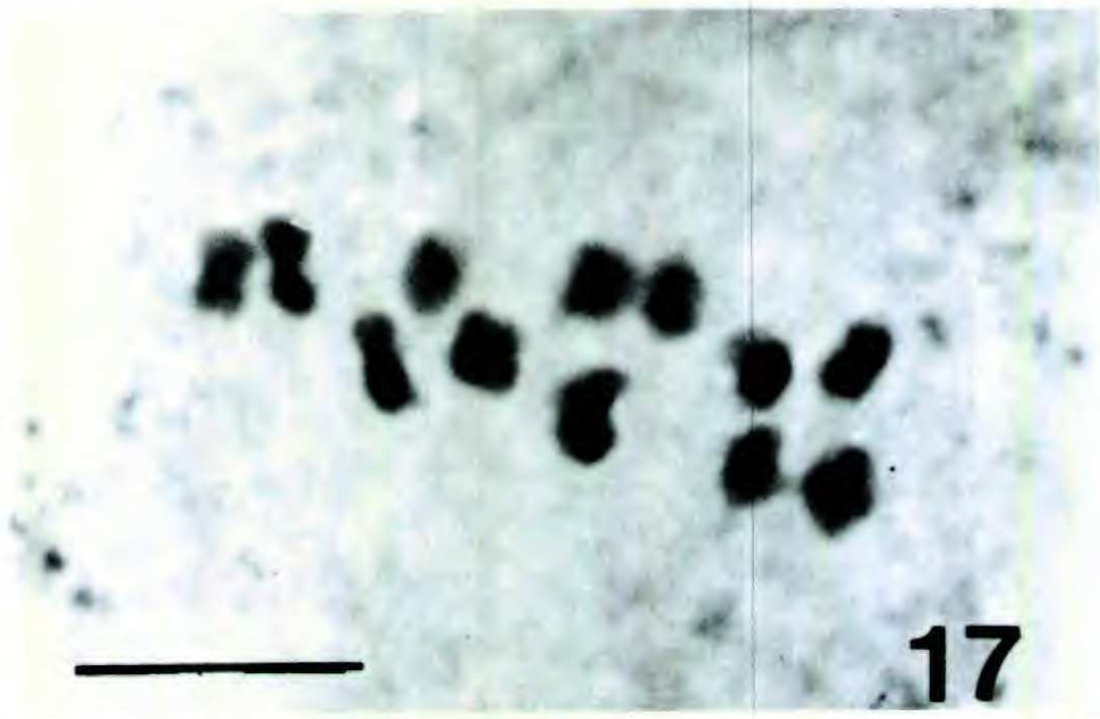

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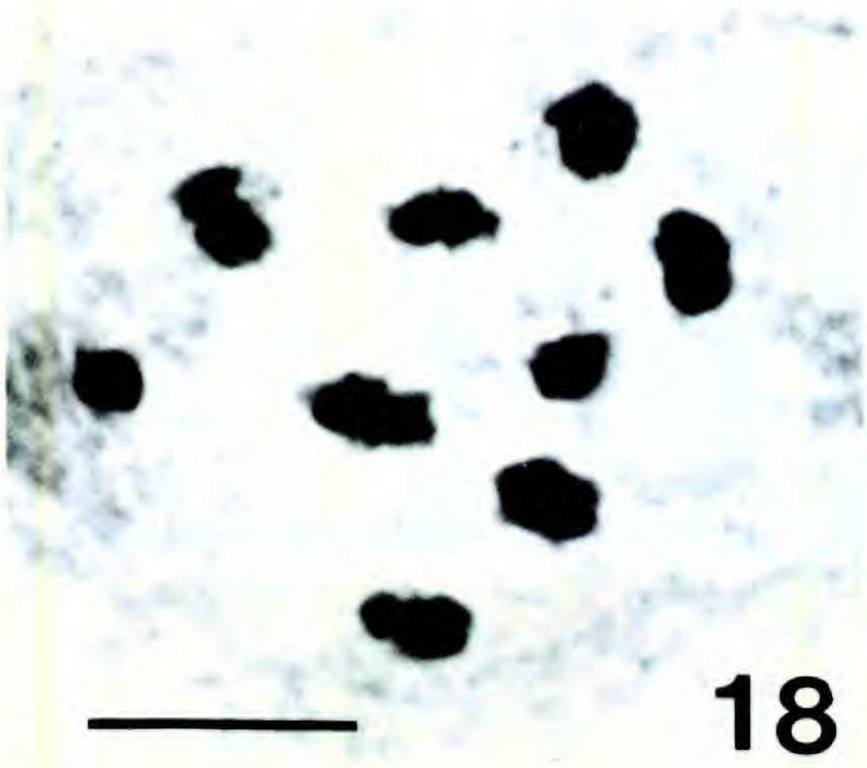

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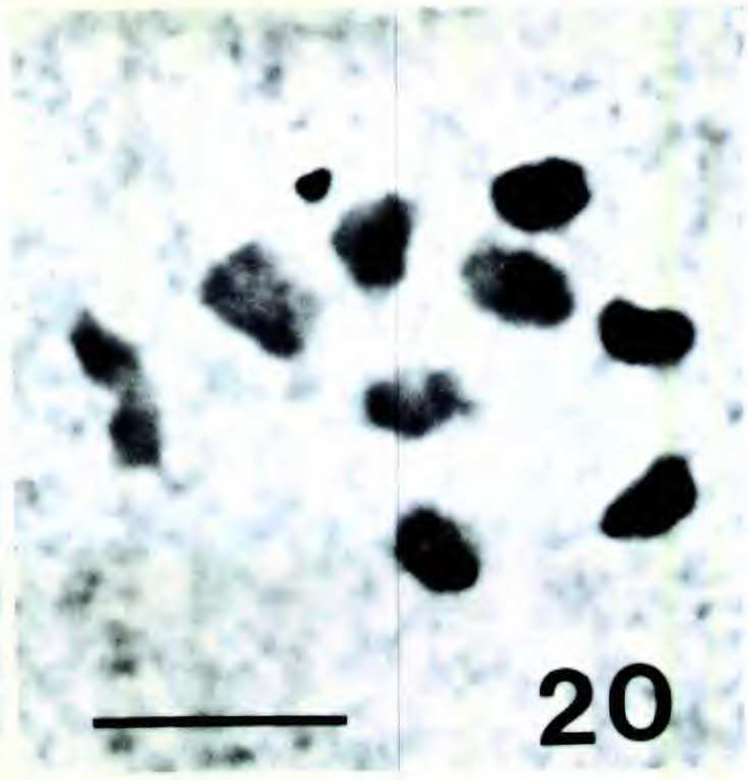

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nesis.—17. Ehrharta longigluma, n = *12, metaphase I.—18.* Anthephora argentea, n = *9, diakinesis.—19.* Brachiaria chusqueoides, n = *9, diakinesis.—20.* Brachiaria glomerata, n = *9, diakinesis. Scale lines = 10 μm.*

ly indicates that the genus has a base number of $x = 15$, which itself was probably derived by polyploidization from $x = 5$, the base number for the tribe (Clayton & Renvoize, 1986). The number in *M. violaceum*, if it can be confirmed, was probably derived by secondary aneuploidy from $n = 15$. It also gives support for the continued recognition of this genus from the related *Miscanthus*, which has $x = 19$ (Clayton & Renvoize, 1986).

TRIBE ARUNDINEAE

The $n = 24$ (Fig. 2) count for one population of *Centropodia glauca* is consistent with the $2n = 24$ reported by De Wet (1954a) and Sokolovskaya & Probatova (1978) for *C. forskalii* (Vahl) Trin., as well as with the prevalent base number $x = 6$ for the tribe (Davidse, 1988).

TRIBE AVENEAE

De Wet (1958) reported a Transvaal population of *Agrostis lachnantha* to be tetraploid with $2n = 28$, but our sample had $n = 21$ (Fig. 5) and is thus hexaploid. Meiosis in *Helictotrichon turgidulum* ($n = 14$) was slightly irregular with the common occurrence of a single quadrivalent. All other chromosomes paired as bivalents.

TRIBE PANICEAE

Brachiaria nigropedata has been reported as diploid from South Africa (De Wet, 1954b; De Wet & Anderson, 1956) and tetraploid from Zimbabwe (Moffett & Hurcombe, 1949). We now add an octoploid count ($n = 36$) based on our analysis of a Transvaal population (Fig. 6).

Echinochloa haploclada has up to now been known as a diploid with $2n = 18$ from Tanzania (Tateoka, 1965) and as diploid (Malik & Tripathi, 1969) and tetraploid ($2n = 36$) from Kenya (Yabuno, 1966). We confirmed the diploid number for a Transvaal population and also found two nearby populations to be hexaploid ($n = 27$; Fig. 8). As presently circumscribed, *E. haploclada* is morphologically variable, and broadly based cytotaxonomic studies may help interpret this variation. Since diploids have never been found outside Africa in *Echinochloa*, Yabuno (1973) considered Africa to be one of the centers of origin for the genus. Our results strengthen this interpretation.

Spies & Du Plessis (1988) reported *Panicum stapfianum* as tetraploid ($n = 18$) from a population in the southern Cape Province, whereas we determined a northern population to be diploid ($n = 9$; Fig. 11).

Pennisetum villosum, a native of northern Africa, now widely naturalized in the tropics and subtropics, has been reported as a eudiploid to euhexaploid. Bridges and fragments were observed at anaphase I in the hexaploid ($n = 27$) plant that we examined. The occurrence of triploids, pentaploids, and hexaploids with irregular meiosis suggests the likelihood of apomixis in this species.

Conclusions

The basic chromosome numbers calculated for all the genera sampled in this study agree with those previously reported. Aneuploid numbers turned up in seven species.

Based on this report and chromosome numbers previously published for South African grasses, ploidy levels were determined for all the species included in this study from any part of their distributional range. On this basis 24 species (53%) of the 45 are polyploid in some part of their range. This is somewhat on the low side for grasses in general since most estimates for polyploidy among grasses are higher than 60% (Davidse et al., 1986). Analyzing this further, 47% of the species we studied are known only as diploids, 24% only as polyploids, and 29% as both diploids and polyploids. Although this sample is small (7% of the 895 species listed by Gibbs Russell et al., 1985) and may therefore not be very representative of the southern African grass flora, the percentages of species only known as diploids and only as polyploids are the reverse of that found in the Zimbabwean grass flora (Davidse et al., 1986). Whether this represents a real geographical trend or is random variation awaits further intensive sampling of the rich African grass flora.

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